Safety Precautions taken for ODH in Labs E and F Resulting from a Rupture of the LN_2 Supply Line from the External 3000 Gallon Tank

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A 3000 gallon (11360 liter) liquid nitrogen tank has been installed outside of Lab F to keep the Tohoku Bubble Chamber Magnet LN_2 shields cold. All vaporized LN_2 is vented outside through the 6" vent pipe. In the event of a rupture or mistaken disçonnection of the incoming LN_2 line, a possible ODH situation might be present.

The flow of LN_2 into Lab F has been limited to 300 ℓ/hr[1] by placing an orifice in the supply line between the dewar and the building wall. This flowrate is equivalent to

$$300\ell \frac{LN_2}{hr} * \frac{700\ell\ N_2 \text{ gas @ room temperature}}{1\ell\ LN_2} = 210{,}000\ell \frac{N_2 \text{ gas}}{hr} * \frac{5.531*10^{-2} f^3}{\ell} * \frac{1 \text{ hr}}{60 \text{ min}}$$
$$= 124 \text{ CFM}$$

of nitrogen gas at room temperature entering the building. In the event of a rupture of the supply line inside the building, we have made the following installations to guard against an ODH injury from long term N_2 venting.

An oxygen monitoring system set to trip at O_2 levels $\leq$ 18% or $\geq$ 23% has been installed in Lab F. This system is identical to that presently in use in the accelerator tunnels. For our situation 3 oxygen monitoring heads have been placed in the vicinity of the Tohoku Bubble Chamber in the following locations;

1. On the southeast column of Platform B

2. On the northeast column of Platform A

3. On the building column located next to the darkroom door.

All heads were positioned approximately 2 feet above the floor. Signals are sent from the monitoring heads to a control panel located in the bubble chamber control room. Through this control panel we have interlocked a visual and audio warning system (see figure). In the event of the detection of an oxygen deficiency or if the signal leads from the O_2 heads are disconnected, a pair of horns will sound and a pair of flashing blue lights will be engaged. Two horn-light pairs are respectively located on the east and west side of the bubble chamber approximately 8 feet above the floor. If tripped, these warnings, utilizing power, will continue to operate until the air's oxygen content reaches a safe level. If power is lost in the building

a 6 amp hour battery located in the control panel will allow oxygen levels to be monitored for a few days. If a trip occurs when power has been lost a fresh battery can drive the horns and lights for roughly 50 minutes.

A normally closed solenoid valve and a blower have also been interlocked with the oxygen monitoring system. The solenoid valve, which is energized open to provide a continuous supply of LN_2 to the magnets nitrogen dewars, will deenergize to the closed position when the system detects an oxygen deficiency or if power to the buildings is lost. The blower is located in the southwest end of Lab F and is 3 feet above the floor. The mouth of the inlet duct is positioned at floor level and the blower vents to the outside environment through the south wall of the building. The blower is driven by a 3 phase, 460V, 60HZ, 1-1/2 HP motor at 2610 RPM and will move 2275 cfm of air. This is about 18 times the maximum rate at which N_2 gas could enter the building from the 3000 gallon dewar. The blower is started by the system if an oxygen deficiency occurs by energizing a set of contacts which allows power to be supplied to the motor. Once started the motor is isolated from the monitoring system and can only be stopped manually.

Summary: An oxygen monitoring system has been installed in Lab F in the vicinity of the Tohoku Bubble Chamber. The primary purpose of this system is to alert personal in the building of an ODH hazard resulting from a break in the bubble chamber's LN_2 supply line. The system's secondary purposes are to shut off the supply of LN_2 to the building if a hazard develops and to attempt to remove at least a portion of the gas that is causing the hazard. These goals are accomplished in the following manner.

> Three O_2 heads monitor the atmosphere tripping an interlock in the control panel if a deficiency exist. This fault condition enables a pair of horns and a pair of flashing blue lights which give an audio and visual alarm to personel of a developing ODH hazard. Additionally, the interlock system eliminates the cause of the hazard by deenergizing a normally closed solenoid valve in the LN_2 supply line and alleviates the hazard by starting a large capacity blower which vents the offending gas outside of the building.

While no system is absolutely fail safe it is felt that the precautions we have taken and have described above are much more than adequate in alerting and protecting an individual from an oxygen deficiency problem which could result from use of the 3000 gallon LN_2 dewar.

[1] Craddock, W, "ODH in Lab E and F from the 3000 Gallon External LN_2 Tank", Tohoku Bubble Chamber Safety Documents Formerly Submitted to the Safety Review Panel, #19, March 22, 1985.

FERMILAB

ENGINEERING NOTE

SECTION	PROJECT	SERIAL - CATEGORY	PAGE
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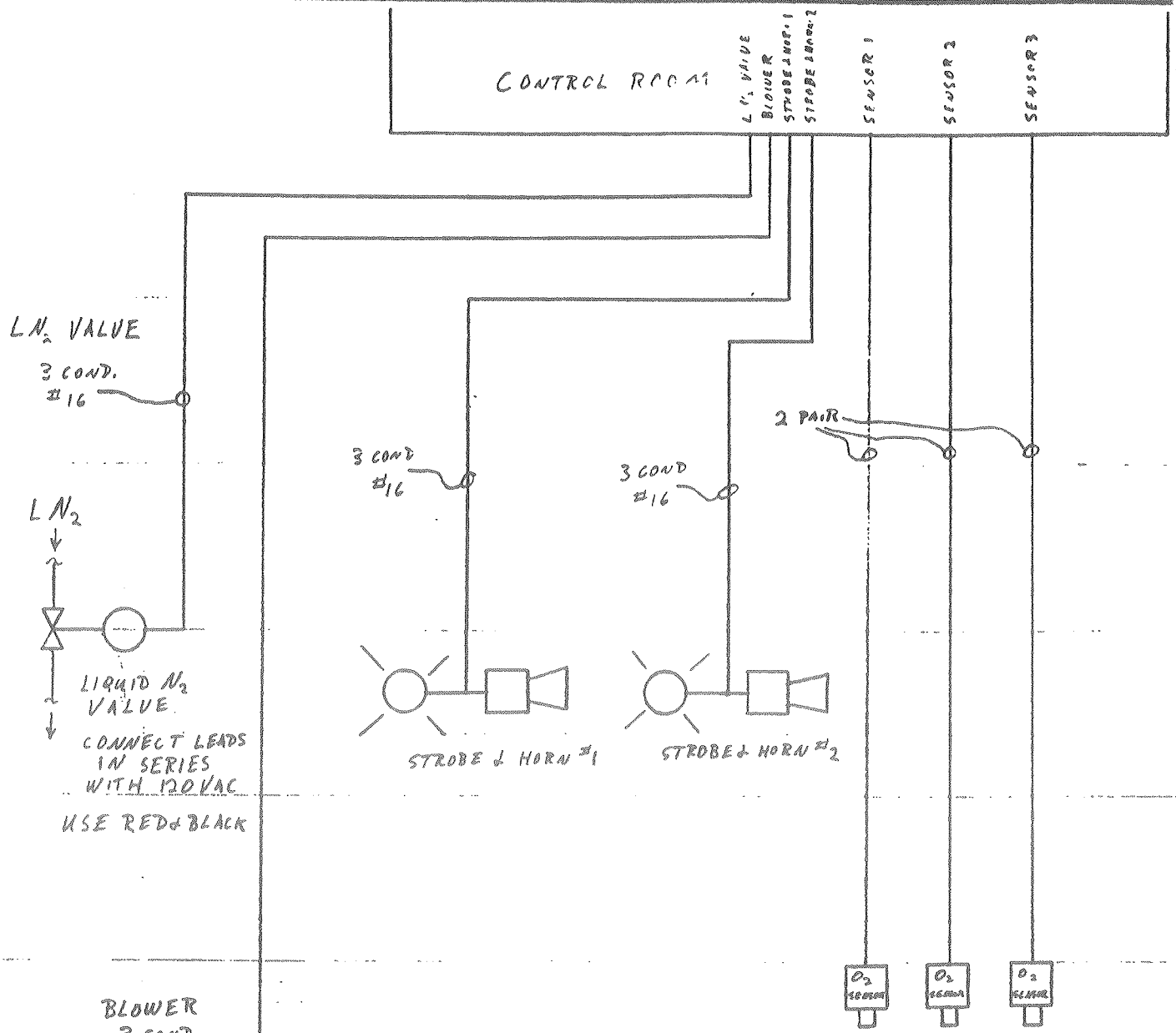
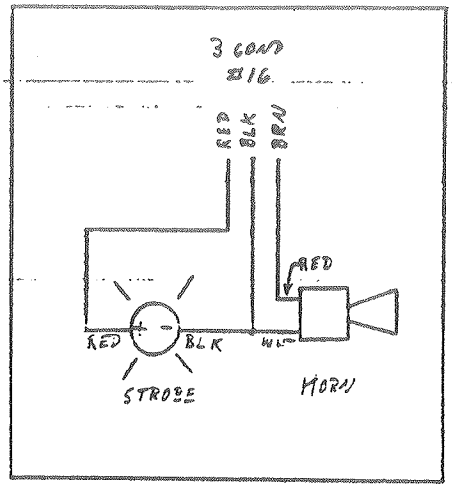
SUBJECT: CABLE ROUTING
LAB F O_2 DEFICIENCY MONITOR

NAME: D. SCHOO

DATE: 5-9-85

REVISION DATE:





STROBE & HORN TYPICAL WIRING

ENGINEERING NOTE

SUBJECT: WIRING DETAILS
LN_2 VALVE AND BLOWER CONTROL

NAME: D. SCHEO

DATE: 5-10-85

REVISION DATE: